09/823677

Practitioner's Docket No. STL9563

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Number: **6,995,947**
Issued: **February 7, 2006**
Name of Patentee: **Seagate Technology LLC**
Title of Invention: **REDIRECTING FLOW TO REDUCE DISTURBANCES UPON AN ACTUATOR ARM OR HEAD-GIMBAL ASSEMBLY OF A DISC DRIVE**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
ATTN: Certificate of Correction Branch

REQUEST FOR CERTIFICATE OF CORRECTION OF PATENT FOR PTO MISTAKE (37 C.F.R. § 1.322(a))

1. Attached is PTO/SB/44 (also Form PTO-1050) in a form suitable for printing.

2. The exact page and line number where the errors are shown correctly in the application file are:

Page 9, line 29 of the specification
Page 2, line 9 of the Examiner's amendment included with the Supplemental Notice of Allowability mailed November 4, 2005 (Note: Claim 8 is Claim 1 in issued patent)
Page 2, line 7 of Claim 8 in Applicant's amendment filed March 4, 2005
Page 2, line 11 of the Examiner's amendment included with the Supplemental Notice of Allowability mailed November 4, 2005
Page 2, line 13 of the Examiner's amendment included with the Supplemental Notice of Allowability mailed November 4, 2005 (Note: Claim 17 is Claim 3 in issued patent)
Page 2, line 16 of the Examiner's amendment included with the Supplemental Notice of Allowability mailed November 4, 2005
Page 3, lines 6-8 Applicant's amendment filed March 4, 2005

(See supporting documents)

3. Please send the Certificate to:

Name: Randall K. McCarthy

Address: Fellers, Snider, Blankenship, Bailey & Tippens, PC
100 North Broadway, Suite 1700
Oklahoma City, OK 73102-8820

Randall K. McCarthy, Registration No. 39,297
Attorney of Record

REDIRECTING FLOW TO REDUCE DISTURBANCES UPON AN ACTUATOR ARM OR HEAD-GIMBAL ASSEMBLY OF A DISC DRIVE

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority to United States Provisional Application Number 60/193,686 filed March 31, 2000.

FIELD OF THE INVENTION

This invention relates generally to the field of data handling devices, and more particularly to directing gas flow within electromechanical data storage devices to permit more accurate transducer positioning.

BACKGROUND OF THE INVENTION

Computers commonly use disc drives or tape drives to store large amounts of data in a form that can be readily accessed by a user. A typical disc drive generally includes a stack of vertically spaced magnetic discs that are rotated at high speed by a spindle motor. The surface of each disc is divided into a series of concentric, radially spaced data tracks in which the data are stored in the form of magnetic flux transitions. Each data track is divided into a number of data sectors that store data blocks of a fixed size.

Data are typically stored and accessed on the discs by an array of read/write heads mounted to a rotary actuator assembly, or "E-block." Typically, the E-block includes a plurality of actuator arms which project outwardly from an actuator body to form a stack of vertically spaced actuator arms. The stacked discs and arms are configured so that the surfaces of the stacked discs are accessible to the heads mounted on the complementary stack of actuator arms.

Head wires included on the E-block conduct electrical signals from the heads to a flex circuit, typically, which in turn conducts the electrical signals to a flex circuit bracket mounted to a disc drive basedeck. For a discussion of some modern E-block assembly techniques, see U.S. Pat. 5,404,636 entitled "Method of Assembling a Disk Drive Actuator" issued Apr. 11, 1995 to Frederick M. Stefansky et al., and assigned to the assignee of the present invention.

The actuator body pivots about a cartridge bearing assembly which is mounted to the disc drive housing at a position closely adjacent the outer extreme of the discs. The actuator assembly includes a voice coil motor which enables the actuator arms and the heads attached thereto to be rotated about the cartridge bearing assembly so that the arms move horizontally (i.e. in a plane parallel to the surfaces of the discs) to selectively position a head adjacent to a preselected data track.

The voice coil motor includes a coil mounted radially outwardly from the cartridge bearing assembly, the coil being immersed in the magnetic field of a magnetic circuit of the voice coil motor. The magnetic circuit comprises one or more permanent magnets and magnetically permeable pole pieces. When current is passed through the coil, an electromagnetic field is established which interacts with the magnetic field of the magnetic circuit so that the coil moves in accordance with the well-known Lorentz relationship. As the coil moves, the actuator body pivots about the pivot shaft and the heads move across the disc surfaces.

Each of the heads is mounted to an actuator arm by a flexure which attaches to the end of the actuator arm. Each head includes an interactive element such as a magnetic transducer which either senses the magnetic transitions on a selected data track to read the data stored on the track, or transmits an electrical signal that induces magnetic transitions on the selected data track to write data to the data track. Air currents are caused by the high speed rotation of the discs. A slider assembly included on each

head has an air bearing surface which interacts with the air currents to cause the head to fly at a short distance above the data tracks on the disc surface.

There is a generally recognized trend in the industry to increase track density, making more and more accurate track following necessary. At the same time, increasing disc rotation speeds have resulted in more and more noise energy being transferred to each arm and head-gimbal assembly by wind. This acts as a disturbance having energy distributed across a wide spectrum of frequencies. This makes accurate track following difficult, especially when it includes significant energy at any of the resonance frequencies of the arms. Thus, there is a need for an improved technique for reducing wind-induced disturbances upon arms and head-gimbal assemblies of the disc drive.

The present invention provides a solution to this and other problems, and offers other advantages over the prior art.

SUMMARY OF INVENTION

The present invention is a method of reducing a flow-induced disturbance on an actuator arm of a disc drive. It includes a step of receiving a gas flow generated by a rotation of a first disc of the disc drive. The received flow is guided along a surface mechanically isolated from the actuator arm. The surface redirects the received flow to include a substantial inward radial component so as to be better aligned along a leading edge of the actuator arm, thereby exerting less force upon it.

Optionally, the guiding also increases the turbulence of the flow to a moderate degree just upstream from the actuator, which is believed to make it less likely for structural resonances to develop fully. These and

other features and benefits will become apparent upon a review of the following figures and their accompanying detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a disc drive configured to implement the present invention.

Fig. 2 shows a flowchart of a method of the present invention.

Fig. 3 shows a top view of the disc drive of **Fig. 1**, showing in more detail how it can perform the method of **Fig. 2**.

Fig. 4 plots a disturbance indicator as a function of actuator position for various heads, with and without the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in general, and more particularly to **FIG. 1**, shown there is a disc drive **100** configured to implement the present invention. Disc drive **100** includes a housing **150** containing several discs **140** in a stack arranged for co-rotation in a conventional manner. Preferably, the discs **140** are each at least 50 mils thick. The cover for the housing (not shown) provides a conventional sealed environment. The top and bottom flat surfaces of each disc **140** each include many thousands of circular tracks **132** containing data. A rotary actuator **110** supports several transducer heads **160** each supported on a respective arm **111** adjacent a respective surface of a disc **140**. A conventional voice coil motor **130** controls the position of the actuator **110** so that a selected one of the heads **160** is positioned above a selected track **132**. Once the head **160** is following the selected track **132**, data can be retrieved from or written to the track **132** via a flex connector **164** through which data signals flow.

The discs **140** spin, counterclockwise as shown, at several thousand revolutions per minute. This causes a wind of hundreds of feet per second

to bear upon the leading edge **176** of each actuator arm **111**, sometimes causing a flow-induced disturbance upon the actuator arm **111** that makes track following difficult. In prior art configurations, air traveling substantially tangent to the disc circumference could collide with a leading edge of an actuator at angles within 30 degrees of the normal, especially when track following at the innermost track.

According to the present invention, a wind-induced disturbance is reduced by redirecting a portion of the flow inward so that the wind is better aligned along a leading edge of the actuator arm. In the embodiment of **Fig. 1**, this is accomplished by a J-shaped channel **172** having a uniform width **323** and depth **123**. Put another way, so that the channel **172** can accommodate a significant flow, all of the cross sections along the channel have a width 323 greater than R/100, where R is the nominal radius **311** of the disc. Most importantly for present purposes, the J-shaped channel **172** includes a redirecting surface **173** that is mechanically isolated from the actuator arm.

As used herein, a surface is "mechanically isolated" from an actuator arm if the surface is only coupled to the actuator arm through the actuator body. Suitable isolation may be obtained by providing the surface on a structure coupled to the housing **150** or to the body of the actuator **110**, for example.

Fig. 2 shows a method **200** of the present invention comprising steps **205** through **235**. A flow traveling along an edge of a rotating disc is received **210** and redirected toward the inner diameter of the disc. The redirected flow is then combined with a circumferential flow traveling along an edge of the disc **225**. The combined flow (shown in region **174** of **Fig. 1**) then has a substantial inward radial component. (As used herein, a flow direction has a "substantial" radial component if the flow direction differs from the tangent direction by about 2 degrees or more.)

While the just-combined flow **346** still has a substantial inward radial component, it is passed along the leading edge of each actuator arm so as to reduce a windage-induced disturbance. The combined flow can optionally be permitted to laminarize while the disc carries the flow through about 10 - 90 degrees of its rotation.

Fig. 3 shows a top view of the disc drive **100** of **Fig. 1**, highlighting how the disc drive **100** of **Fig. 1** can perform the method of **Fig. 2**. The axis of rotation **374** of the actuator is shown, as is the axis of rotation **376** of the disc stack. Radius **311** is shown explicitly, and radius **355** is shown in part, marking the leading side of the combined flow region **174** (of **Fig. 1**). Within the half-circle upstream from (i.e. below) radius **355** near the discs, it can be assumed for present purposes that all of the air travels substantially tangent to the rotation. For example, flow **345** flows in a substantially tangent direction. As used herein, "substantially tangent" means within two degrees of being tangent to a centered about axis **376**. (In ordinary disc drives, flow very near each disc will actually have a somewhat more outward direction than flow mid-way between successive discs, a centrifugal effect.)

An air flow **342** traveling along the circumference of a disc **140** is initially received at the inlet of the channel **172**. The inner radius **321** and the outer radius **322** of the channel **172** have a difference equal to the inlet width **323**, so that the channel maintains a nominally constant cross-sectional area along its J-shaped length. Encountering the curved wall **173**, the redirected flow **343** therefore maintains a nearly-constant speed even as it is expelled **344**. The fastest portion of the expelled flow **344** is directed toward the inner diameter **361** of each disc **140**, encountering the tangential flow **345** at an angle **327** of about 90 degrees. In preferred embodiments, the area-averaged injection angle **327** is at least about 30 degrees.

The combined flow **346** has a direction including a substantial inward radial component, as shown by the angle **326** departing from

tangent by several degrees. The mixed flow region **174** upstream from each actuator arm **176** is characterized by a substantial inward flow direction component. After rotating with the disc about a travel angle **328** of about 30 to 60 degrees, the combined flow **346** encounters the leading edge **176**. A larger travel angle will tend to laminarize the just-combined flow **346** but decrease its inward angle **326**. In preferred embodiments, most of the area of the leading edge **176** of the actuator arm **111** comes in contact with the mixed flow **346,348** before the mixed flow travels about an angle **329** of less than 90 degrees.

As the just-combined **346** flow draws very near the leading edge **176**, it is redirected again. Part of the just-combined flow **346** travels above and below the actuator arm **176** in manner similar to that of the prior art. More importantly, part of the flow **348** travels along the leading edge **176**. Because the combined flow **346** transfers less energy to the actuator arm **111** than an ordinary tangent flow **345** would, especially at a resonance frequency F of the actuator arm, disc drives **100** performing the present method are better able to follow tracks **132** accurately.

Fig. 4 plots disturbance indicator as a function of actuator position **401**. Actuator position **401** is expressed as a track (cylinder) number. The 0th track is at the outer diameter, and the inner diameter is numbered about 10,000. The disturbance indicator is Non-Repeatable Run Out (NRRO) expressed in microinches **402**. At each of several measurement cylinders, a position error signal (PES) indicates a measured deviation from an expected radial position many times. These measurements were divided into three groups, each group being used to derive a respective mean and a standard deviation. The means each represent Repeatable Run Out (RRO), which was ignored for present purposes. The standard deviations, expressed in microinches, were averaged to obtain the present indicator of NRRO **402**.

The disc drive from which the data of **Fig. 4** were gathered had five discs, each with two surfaces. The heads were conventionally numbered 0 through 9. Before the method of the present invention was performed within the drive, head 0 resulted in NRRO indicator **440**, head 1 resulted in NRRO indicator **441**, and head 5 resulted in NRRO indicator **445**. This reflects the fact that heads near the top and bottom disc generally suffered worse NRRO than heads near the middle disc. It is believed that stationary surfaces above and below the disc stack served to dampen the flow impinging upon the actuator arms near the top and bottom, especially those coupled to heads 0 and 9. This is supported by the fact that the worst case NRRO was always measured near the inner diameter (on the right side of **Fig. 4**) for the heads positioned between discs (i.e. heads 1 through 8).

After the disc drive was reconfigured to perform the present method, head 0 showed a greatly reduced indication **450** of NRRO. Heads 1 and 5 also showed greatly reduced NRRO indications **451,455**. For all of the heads positioned between discs, this improvement was more than 3% across all actuator positions **401**. This is significant evidence of the importance of the present invention, especially in view of the present concern that track densities are becoming too high to allow track following by existing methods.

By way of review, a first alternative embodiment of the present invention is a method (such as **200**) of reducing a flow-induced disturbance on an actuator arm (such as **111**) of a disc drive (such as **100**). A gas flow (such as **342**) generated by a rotating disc (such as **140**) is received (e.g. by step **210**) and passed along a surface (such as **173**) mechanically isolated from the actuator arm(s). The surface redirects the flow to include a substantial inward radial component (e.g. by step **215**). Preferably, the redirected flow (such as **344**) is expelled toward an inner diameter (such as **361**) of the disc (such as **140**). The redirected flow (such as **344**) is then

combined (e.g. by step **225**) with a tangent flow (such as **345**) so that the combined flow (such as **346**) has a net flow direction with an inward radial component (such as **326**). The combined flow (such as **346**) is redirected again by the actuator arm(s) (such as **111**), preferably before it travels 1/4 of a revolution of the disc. The redirected flow (such as **348**) along the leading edge is shown in **Fig. 3**. Because the just-combined flow (such as **346**) is better aligned with the leading edge (such as **176**) of the actuator arm than a tangential flow encountering the actuator arm would be, the flow-induced disturbance on the actuator arm is reduced by the present method.

A second alternative embodiment is a disc drive (such as **100**) well-suited for performing the above method (such as **200**). The disc drive has multiple discs (such as **140**) and an air flow channel (such as **172**) positioned upstream of an actuator arm (such as **111**). The channel has a horizontal cross-section with a minimum macroscopic radius of curvature (such as **322**) greater than R/100 so that the flow is redirected with a minimum drag-induced energy loss. The flow may optionally be passed along textured channel surfaces (with recesses smaller than R/1000 in depth and diameter) so as to reduce drag further. Preferably, the cross-sectional area of the channel is sufficiently uniform along the length of the channel so that, downstream from the channel inlet, flow speed is maintained within 50% all along the curved channel. Alternatively, the flow can be guided so as to remain at a uniform height along the channel(s). The channel is vertically uniform (as shown in **Fig. 3**) so that the inward radial component of the redirected flow will be larger between the discs than above or below the stack of discs. For ease of implementation, also, the curved surface (such as **173**) preferably does not extend above or below any of the major surfaces of the discs (such as **140**).

In a third alternative embodiment, the turbulence of (most or all of) the flow is increased while the flow is redirected. This increase

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/823,677	03/30/2001	Kurt James Korkowski	STL9563	6119

7590 11/04/2005

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MAY 05 2006
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EXAMINER	
DAVIS, DAVID DONALD	
ART UNIT	PAPER NUMBER
2652	

DATE MAILED: 11/04/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

RECEIVED
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PTO-90C (Rev. 10/03)

MAY 09 2006

Supplemental Notice of Allowability	Application No. 09/823,677	Applicant(s) KORKOWSKI ET AL.	
	Examiner David D. Davis	Art Unit 2652	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the amendment received August 29, 2005*.

2. ☒ The allowed claim(s) is/are *8, 9, and 17 renumbered 1-3 respectively*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date _____.
7. ☒ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

David D. Davis
Primary Examiner
Art Unit: 2652

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mitchell K. McCarthy on October 27, 2005.

The application has been amended as follows:

Claims 5, 6, 10, 11 and 16 have been cancelled.

In line 2 of claim 8, --only-- has been inserted after "redirecting".

In line 6 of claim 8, --to combine with a non-redirected portion of the gas flow, the combined gas flow thereby deflecting the non-redirected portion of the gas flow toward the inner diameter-- has been inserted after "disc".

In line 3 of claim 17, --only-- has been inserted after the first occurrence of "of".

In line 6 of claim 17, "the portion of the gas flow" has been changed to --the combined flow--.

In line 5 of claim 17, -- to combine with a non-redirected portion of the gas flow, the combined gas flow thereby deflecting the non-redirected portion of the gas flow toward the inner diameter-- has been inserted after "disc".

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David D. Davis whose telephone number is 571-272-7572. The examiner can normally be reached on Monday thru Friday between 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hoa T. Nguyen can be reached on 571-272-7579. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

David D. Davis
Primary Examiner
Art Unit 2652

ddd

Interview Summary	Application No.	Applicant(s)	
	09/823,677	KORKOWSKI ET AL.	
	Examiner	Art Unit	
	David D. Davis	2652	

All participants (applicant, applicant's representative, PTO personnel):

(1) *David D. Davis*. (3)_____.

(2) *Mitchell McCarthy*. (4)_____.

Date of Interview: *27 October 2005*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☐ No.
If Yes, brief description: _____.

Claim(s) discussed: *5,6,8-11,16 and 17*.

Identification of prior art discussed: *Ho et al (US 4,282,554)*.

Agreement with respect to the claims f)☒ was reached. g)☐ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *See attached Examiner's Amendment*..

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

Agreem[illegible]

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Examiner's signature, if required

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MAR-04-05 16:48 FROM:FSBBT ID:4052328659 PAGE 1/14

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DATE: March 4, 2005 AUTO QUOTE: 73401

NUMBER OF PAGES INCLUDING THIS COVER SHEET: 17

FROM: Mitchell K. McCarthy, Registration No. 38,794

TO: Mail Stop Amendment
Commissioner for Patents
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ADDRESSEE/ORGANIZATION	FAX NO.	TELEPHONE NO.
Art Group 2652	703/872-9306	866/217-9197

RE: Application No. 09/823,677
In re application of: Kurt James Korkowski, et al.
Assignee: SEAGATE TECHNOLOGY LLC
Dkt. No.: STL9563

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PATENT
Dkt. STL9563

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	**Kurt James Korkowski and James Eiji Kaneko**		
Assignee:	**SEAGATE TECHNOLOGY LLC**		
Application No.:	**09/823,677**	Group Art Unit:	**2652**
Filed:	**March 30, 2001**	Examiner:	**David Davis**

For: **REDIRECTING FLOW TO REDUCE DISTURBANCES UPON AN ACTUATOR ARM OR HEAD-GIMBAL ASSEMBLY OF A DISC DRIVE**

Mail Stop Amendment
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO OFFICE ACTION
MAILED DECEMBER 7, 2004

Sir:

Please enter the following amendments in the above identified United States patent application.

Amendments to the Claims are reflected in the Listing of Claims beginning on page 2 of this paper.

Remarks begin on page 6 of this paper.

CERTIFICATION UNDER 37 C.F.R. §§ 1.8(a)

I hereby certify that, on the date shown below, this correspondence is being:

TRANSMISSION

☒ facsimile transmitted to the Patent and Trademark Office, (703) 872 - 9306.

Diana C. Anderson
Signature

Date: March 4, 2005

Diana C. Anderson
(type or print name of person certifying)

#302270

Amendments to the Claims:

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

1. – 4. (Cancelled)

5. (Previously presented) A method of reducing a flow-induced disturbance on an actuator arm of a disc drive, comprising redirecting a portion of a tangential gas flow generated by a rotation of a first disc of the disc drive along a surface mechanically isolated from the actuator arm and toward an inner diameter of the disc.

6. (Previously presented) The method of claim 5 in which the disc has a nominal radius R and in which the surface defines a channel comprising a radius of curvature greater than R/100.

7. (Previously presented) The method of claim 6 in which the disc drive further includes a second disc configured for co-rotation with the first disc, and in which the channel spans both discs so that the redirected gas flow enters a space between the discs.

8. (Currently amended) ~~The method of claim 5 wherein the redirected portion of the gas flow combines with the rest of the tangential gas flow upstream of the actuator arm~~ A method of reducing a flow-induced disturbance on an actuator arm of a disc drive, comprising redirecting a portion of a tangential gas flow generated by a rotation of a first disc of the disc drive along a surface mechanically isolated from the actuator arm and impinging the redirected portion on an outer edge of the first disc in a direction toward an inner diameter of the disc.

9. (Previously presented) The method of claim 8 comprising a second redirecting of the combined flows with the leading edge of the actuator arm before the combined flows travel ¼ of a revolution of the disc.

10. (Previously presented) The method of claim 5 wherein the redirected portion of the gas flow comprises a velocity that is at least 50% of the tangential gas flow velocity.

11. (Previously presented) The method of claim 6 in which the disc has a nominal radius R and in which the channel forms a lateral width that is greater than R/100.

12. – 15. (Cancelled)

16. (Previously presented) The method of claim 5 wherein the disc drive has a second disc configured for co-rotation with the first disc, and wherein the surface does not extend into a space between the first and second discs.

17. (Currently amended) A method of reducing a flow-induced disturbance on an actuator arm of a disc drive, comprising:

a first redirecting of a portion of a tangential gas flow generated by a rotation of a first disc of the disc drive along a surface mechanically isolated from the actuator arm and toward an inner diameter of the disc; and

~~The method of claim 5 comprising~~ a second redirecting of the portion of the gas flow with the leading edge of the actuator arm before the redirected portion of the gas flow travels ¼ of a revolution of the disc.

18. (Withdrawn) A turbulence attenuation device for an actuator in a data reading and writing relationship with a rotatable storage media, comprising:

a shroud disposed adjacent to an edge of the disc adapted for defining a tangential fluid flow generated by a rotation of the media;

surfaces defining a channel in fluid communication with the shroud, the channel comprising an inlet adapted for admitting a portion of the tangential fluid flow in a direction away from the disc, and an opposing outlet directing the portion of the tangential fluid flow toward an inner diameter of the disc.

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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,995,947

APPLICATION NO.: 09/823,677

ISSUE DATE : February 7, 2006

INVENTOR(S) : Kurt James Korkowski, et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Col. 6, line 6
replace "or all of"
with --or all of)--.

Col. 6, line 26
replace "comprising only"
with --comprising redirecting only--.

Col. 6, line 31
replace "of the discs"
with --of the disc--.

Col. 6, line 32
replace "the combine gas"
with --the combined gas--.

Col. 6, line 41
replace "redirecting only of"
with --redirecting of only--.

Col. 6, line 44
replace "of the disc; and"
with --of the disc to combine with a non-redirected portion of the gas flow, the combined gas flow thereby deflecting the non-redirected portion of the gas flow toward the inner diameter; and--.

Col. 6, line 48
replace "disc to combine..."
with --disc.--.

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